SIR GEORGE WILLIAMS UNIVERSITY

FACULTY NEWSLETTER

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SIR GEORGE WILLIAMS UNIVERSITY

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Editorial Commentary:

There is the old saying about it being 'better late than never' but, in this instance, there may be some question as to the validity of that saying. As you will note from the list of contents, this edition of the Faculty Newsletter is comprised of only three pieces submitted by three 'sterling' members of the staff who have taken heed of the Editor's plaintive request for material to be published.

With the institution of the new 'Principal's Bulletin', edited by Mr. Trefflé Lacombe, Administrative Assistant to the Principal, there is no further need for the Faculty Newsletter to try to incorporate items of current news which might be of interest to staff-members so that the only function left for the Newsletter to perform will be the publication of articles, poetry, reviews of one kind or another, etc., which staff-members may care to contribute which they feel would be of interest to their colleagues in this academic community.

In the past, the Editor has been supported in his efforts by voluntary contributions of this sort from staff-members but it would appear that the time has come, in view of the current paucity of contributions during the Fall term, to raise the question with all members of this 'we-group' of whether they would wish this publication to continue in existence or not. To this end, you will find on the final page of this edition a questionnaire which you might fill in and return to the Editor as soon as possible.

Season's Greetings.

Should the results of the above-mentioned questionnaire result in a decision to discontinue publication of the Newsletter altogether, the Editor would like to take this opportunity of thanking all members of the staff, both full- and part-time, who have contributed in the past to the Newsletter. These contributions have been appreciated by him and certainly by a considerable majority of other staff-members who have commented favourably on them.

In addition, the Editor would like to take this opportunity of conveying on behalf of himself and all other members of the Administration sincere Good Wishes to all members of the staff for a very Happy Holiday Season - even though the current prospect would seem to be that it will be a 'dry' one unless there be some adventurous 'spirits' amongst the group who are prepared to 'import' contraband from one or other of our neighbouring Provinces.

A MERRY (?) XMAS AND A HAPPY NEW YEAR TO ALL

THE FABULOUS VOYAGE OF MARINER II

This story is almost two years late in the telling, but the details have been released in scientific journals only a bit at a time. It is possible now, however, for the layman to get a more or less complete picture of this most incredible accomplishment of technology in the field of space exploration. It was popularly called the "Venus Probe", and it consisted in launching a spacecraft which, after 3½ months (109 days) passed within hailing distance of Venus, sending back a wealth of information about that mysterious planet.

We had an example this past summer of the uncanny precision of guided capsules when the astronomical engineers crashed a photographic vehicle on the surface of the Moon within a few miles of the projected target, and received from it before the crash over 4,000 marvellous close-up pictures. But that achievement dealt with a body only ¼ of a million miles from Earth: Mariner II was 36 million miles from Earth when it kept its rendezvous with Venus.

The launching of Mariner II took place on August 27, 1962. On December 14th it passed within 22,000 miles of Venus, well within the limit planned for. Its speed varied considerably during the flight but the average was something like 70,000 miles per hour.

The capsule which completed this fantastic journey was a small one as space vehicles go. It measured 10 feet high and 5 feet in diameter, with a pair of wings that could be extended on command for certain manoeuvres with a spread of 16½ feet. It weighed 447 pounds, about 40 pounds representing the load of delicate electronic instruments which were packed into it.

The heart of the load (or, better, the brain) was a miniature computer. Into this was fed, before launching, a complete set of instructions for the journey. These orders were retained in the memory of the instrument and were applied on a pre-arranged time schedule. When anything went wrong, as happened occasionally, the control stations on earth took over saying, as it were "Disregard what your brain is telling you to do and obey the following command" or "Your brain has just missed out: here is what it ought to have told you". There were three of these control stations -- California, South Africa, and Australia -- spaced so that at least one of the stations would always have the spacecraft above its horizon.

As Mariner II approached the planet (the climax of the voyage) the distance from Earth was so great that it took 6½ minutes, at the speed of radiation, for a command to be despatched and an acknowledgment received. This time of closest approach was one of the occasions when the computer failed to function. Orders had to be sent from earth to adjust the instruments for the crucial close observations. If these commands had failed to reach the spacecraft and been acted upon, the main part of the objective of Mariner II would have been a flop. Six and a half minutes is a long time for a scientist to hold his breath.

The complexity of the planned route for the vehicle can be appreciated when it is stated that the spacecraft had to be placed in three successive orbits. The original orbit into which it was launched was a simple one around the Earth, governed by the gravitational field of the Earth. This was referred to as the "parking orbit", for its purpose was only to get the vehicle into position. It remained in this orbit for only 24 minutes. Then a second-stage rocket was fired giving the necessary increase in velocity for the capsule (now free of its launching mechanism) to escape from the gravitational field of the Earth and assume an orbit around the Sun. At the end of 9 days, and when 1½ million miles away from Earth, another adjustment in orbit had to be made to steer the vehicle more precisely towards its rendezvous with Venus. One reason for this is that the plane of orbit of Venus around the Sun is inclined at an angle of 3½° to that of the Earth. This operation was the most ticklish manoeuvre of the flight. The spacecraft was by this time entirely on its own. The complicated set of instructions carried in its computer took 3 3/4 hours to be carried out, but the change of course was successfully achieved. This final orbit was planned with such amazing precision that it carried Mariner II so close to Venus that the gravitational field of the planet caused it to swerve around Venus in a near miss, securing the information it was sent out to obtain.

Mariner II experienced several adventures en route. On its 12th day out it suddenly lost touch with earth for 3 minutes. Evidently it had been jarred from its path, and from its behaviour it is conjectured that it suffered a collision with some solid body in space. This might have been a large meteoric mass, or possibly the hulk of some dead artificial satellite still wandering in space. The capsule, however, righted itself by its own uncanny powers and proceeded on its way, surprisingly without injury to its delicate instruments. On the 65th day a short-circuit occurred resulting in a brief period of silence. This experience was repeated a few days later. In each case, however, the vehicle cured itself and resumed its reporting.

Throughout the flight the pre-arranged schedule of information sent from the capsule was a double one. For 20 seconds came observations of conditions in space and what it could see around it. This was followed by 17 seconds of reports on its own health -- voltages, temperatures, angles of hinged instruments, and so on. This schedule was followed until 6 hours before the actual rendezvous with Venus, when a command was sent from Earth cancelling the health reports so that it could concentrate on its observations. In all, over 11 million coded bits of information were received from Mariner II. These were recorded on magnetic tape and carefully stored in vaults: there is material here for years of pleasurable study.

The details of the close-up observations of Venus are, of course, of more interest to the astronomer than to the layman. Many of them were negative, abolishing previously held theories. One curious fact ascertained is that there was no evidence at all of a magnetic field surrounding Venus as there is connected with Earth. Mariner II was particularly interested in the magnetic fields through which it passed. It carried a magnetometer so sensitive that, when tested in the laboratory before launching, it could detect a metal nail in the shoe of a man standing 10 feet away. There were interplanetary magnetic fields but nothing of the kind in the proximity of Venus. The clouds surrounding the planet, so frustrating to earth-bound observers because they prevent any possibility of seeing the surface features of the planet, were found to be unbroken, thus still hiding surface markings even at the closest approach of the capsule. One result of the project was to determine accurately the mass of Venus from the deflection of the spacecraft when within Venus' gravitational field: the figure obtained corrected the previously held figure significantly. Perhaps the discovery that is of most popular interest is that the planet can never become the abiding place of Earth's overpopulation through colonization: nor can its surface ever be visited by astronauts. The surface temperature of Venus was found to be 800° F. -- above the melting point of lead. And, curiously enough, this figure held both on the sunlit side of Venus and on the side turned away from the Sun.

After fulfilling its function, Mariner II continued on its way faithfully reporting to Earth for an additional 20 days. Then it became permanently silent. It is now a "carcass" (delightful astronomical term) travelling on an eternal orbit around the Sun which it completes in 346 of our terrestrial days.

The next step will probably be to duplicate this achievement with the planet Mars as the objective. There are no clouds covering Mars so the surface features should be open to view. But this problem would be infinitely more difficult than was the case with Venus, and a Mars flight would require seven or eight months. Still, in the present status of space exploration, there is no firm answer to the question "Whatever will you be doing next?"

E. Russell Paterson
Assistant Professor of Natural Science

CULTURE AND COMMUNICATION

An English-speaking Canadian, a member of a bilingual association of women concerned with international affairs, spoke to me recently. She had come from a meeting and was suffering from a sense of frustration. She knew her French-Canadian counterpart well. Both were bilingual, both of intellectual standing; they used the same vocabulary, the same ideas, and both were imbued with goodwill. Yet my friend found that they ended their discussions with the disturbing feeling that they had failed to communicate on a common level of understanding. She could not understand why.

Hers was a problem not difficult to understand. It was not a language problem. It was the result of a subtler difference of culture; the one was a product of what Marshall McLuhan (The Gutenberg Galaxy) calls the 'linear' culture while the other had been born into a 'manuscript' culture.

C.P. Snow in his two books on the Two Cultures discusses the gap in communication between the Humanities and the Sciences. Many teachers in the Humanities claim with justification that they have a good basic knowledge of what is going on in the scientific world, but they miss the point. This is demonstrated when, in aiming to give science students some background in the Humanities, they offer a disconnected patchwork of courses designed for arts students. This breeds a sense of frustration.

The McGill Faculty of Engineering discovered this in discussing with students the problem of a basic need for some grounding in the Humanities. The students admitted the need to know something about the world of the Humanities but vented their frustration at being involved in courses which demanded a volume of study and reading which impaired their concentration on their own courses and added little to their understanding of their civilization. It was a specific complaint illustrating the inability of the Humanities to grasp the gap in communication at the very beginning of the divergence of the Sciences from the Humanities.

A recent graduate of Smith College expressed the basic need in the Atlantic Monthly. "In our complicated world, any simplification of the events around us is welcome and, in fact, almost necessary. We need to feel our place in history; it helps in our constant search for identity."

This is the voice of the student challenging the Humanities, but if the Humanities cannot communicate with the Sciences neither is it without fault in its own field. Dr. Wasserman of Sir George Williams University, aware of this, discussed with the present writer her feeling that the course in General Humanities was not achieving its aim "to enlarge and enrich the student's apprehension of his cultural heritage." A subsequent assessment of examination papers revealed a regurgitation of crammed notes rather than any interest in or understanding of "cultural heritage." Basically, the problem was not the fault of student or lecturer but a communication gap between two cultures, the Ph.D. culture and the modern High School student culture, or, as McLuhan might put it, the gap between the 'linear' culture and the 'electronic' culture.

Culture has become a many-faceted word. McLuhan's patterns of culture are the 'tribal', the 'manuscript', the 'linear' and the 'electronic'. In the tribal culture, custom, legend and myth are the common ground passed from one generation to another orally or by ceremony or dance and so on. The five senses are used in balance, the only extension of the senses being through a sixth sense or magic. In the manuscript culture detribalization has formed larger units of society and the culture is passed on orally from the pulpit or the podium by an educated elite who alone have access to learning through manuscripts. The invention of printing ushered in the linear culture. Knowledge and learning became available to a rapidly increasing proportion of the population of the western world; the visual sense was warped into dominance over the other senses and knowledge was absorbed line after line, book after book; the printed word was a cultural god reaching its peak of influence in the nineteenth century. French Canada, significantly, slumbered during this period, still following the pulpit for the masses and the podium for the few. At the peak of the linear culture the world of men and ideas was perceived from the chair and the book through the single visual sense and the sequence of the printed word.

It was William Blake who prophetically said, "When sense ratios change, men change." Witness the nineteenth century, its violent social upheavals and its culmination in the even more violent upheavals of the twentieth century.

Now, in the electronic culture, the senses are restored to a better balance; we live not only with instant coffee, instant cake, but with an instant world; radio, television and pictures, both moving and still, have given us this instant world independent of the linear, or alphabetical, distillation of information. The world is a village in which the growing child can see an earthquake in Alaska, a poverty-stricken village in South America, a space rocket launched to the moon, a drama, a molecule. The eyes reach, the ear listens, the fingers touch, the mind stretches, emotions respond and the world of men and ideas seeps in through all the senses extended through time, space and magnitude.

It is not without significance that the French-Canadian renaissance should rise to meet this instant world because, having missed so much of the linear culture they are more readily adaptable to the electronic culture than their fellow Canadians, as their response to the medium of television has demonstrated.

When one speaks of the gap in communication between cultures, be they racial, academic or linear-electronic, the immediate thought is of something simple or as obvious as a crevasse over which a bridge can be thrown, but the problem is more subtle.

McLuhan quotes the example of a failure of communication when an educational film was produced by technicians of the electronic culture for Africans still in a tribal culture. It was found that when, during the film, a character walked off the screen, the audience became restless and lost interest in the following scenes.

For the westerner no problem is presented when a character walks off a frame during the projection of a film. Not so for the African. From the beginning the African becomes involved with the characters in the film. When a person moves off the frame it is not possible for him to disappear without going somewhere. Where has he gone? What is he doing? The African becomes more involved in the answer to those questions than in the progress of the film. The film makers found that they had to make a very simple adjustment in communication. If the film followed the disappearing character down the street and round a corner his disappearance became quite natural and the audience could turn its attention to the following sequences with an undisturbed mind. A very minor adjustment bridged a profound gap in communication.

At this stage one might ask what relation the African in his tribal culture has with a student born into an electronic culture faced with a lecturer steeped in the linear culture. There is, I suggest, a similarity. The failure in communication can be equally subtle, equally important, and as easily bridged.

The art of teaching (excluding the Sciences) is suffering from a prevalence of Ph.D.'s., and Ph.D.'s, like a good wine, needs ageing before they are fully mature. They have fermented in the vat of scholarship and their green wine is too strong for the raw student. They have been warped by their years of study deeper and deeper into the linear culture and when, on the podium, they face the students of the electronic culture they meet what seems to them a primitive ignorance. They give forth, the new ones, of the full flood of their scholarship of which they are justly proud, and the student, like the African primitive, sits back and says, "Wait a minute, where does all this fit in?"

Unless understanding is the handmaiden of scholarship the student becomes cynical and settles for picking up enough scraps of knowledge to see him through to a credit. This, of course, is an education in itself, an education for adaptation to a cynical world, but that is hardly the highest function of a university.

One might be irreverent and suggest that the unfledged Ph.D. is at a disadvantage vis-a-vis his students. When they come to him the world, as McLuhan says, is their village; they have been weaned into a two dimensional world of instant information; races and places are no more than hours away, no crisis or current affair more than a few minutes away on television; theirs is a world village in which know-how, adaptability and knowledgeability give a patina to the surface if not understanding in depth. In contrast the Ph.D. has been warped into the single visual sense world of the linear culture, burrowing year after year through the sequential logic of the printed word, finally emerging, pale with scholarship, bearing a thesis on "The Incidence of Long Vowel Sounds in the Poetry of the Restoration Poet, Jonathan Byass," who asked nothing more than to remain decently buried in obscurity.

This, of course, is a caricature of the truth, yet Page Smith touches the same thought in his book, History and Historians. In Canada, Dr. Shum of Simon Fraser University echoes the thought when he says he is prepared to accept a little less learning in return for more light in teaching. On the other side of the Atlantic, Dr. Alec Vidler wrote even more strongly in the Sunday Times, commenting on a series of articles criticising the teaching of the Humanities. In each of the articles, he said, there was the same healthy protest against the dry-as-dust, inhuman and remote way in which the so-called Humanities are increasingly expounded. This protest came, he said, from the heart of the universities.

Yet, so few centuries ago, the Humanities were the vital springboard into the sciences, the breath of a new life in the universities, and the opening of the gateway into the modern world.

Research is as vital to the Humanities as it is to any other branch of teaching, but that research has tended to turn backwards to the dry and dusty areas of abstruse and arid scholarship instead of to the challenging future of better teaching and newer methods of teaching for larger numbers who need it and demand it. The world of teaching is vibrant with new ideas waiting to be explored, improved, tried and tested.

Yet Page Smith says there are now approximately 15 Ph.D. candidates labouring over each year of American history. Heaven knows how many more are pursuing monographs through yellowing records while the world of the Humanities is full of new challenges to teachers and never before have teachers, as distinguished from scholars, mattered so much.

Communication becomes all-important.

Dr. Wasserman inaugurated an experiment in General Humanities 210 to test a new approach to better communication in presenting the story and ideas of western civilization through the combination of the spoken word and multi-image visual presentation. At that time the idea was new and visual aid was regarded as a method of simplification rather than as a possibility of challenging the student to use a wider spectrum of sense perception. The proposal was to use up to five visual impressions woven with, but without explanation in detail, the lecture into a pattern moving through time and space; the chronology and geography, topography, human elements, art and architecture would continually economise or reinforce the spoken word.

The object was to attempt to transform the linear sequence of the spoken word to a kind of algebraical sequence of evolving equations using pictures instead of symbols, on the assumption that one would then be communicating in media familiar to the modern student. If the experiment merely produced a 'gimmick' or an illustrated lecture the purpose would be defeated.

Susan K. Langer in her book, Philosophy in a New Key, says, "Discursive language is one of the richest forms of man's peculiar addiction to symbolization. But it has limitations, it expresses ideas serially, rather than simultaneously--unlike, for example, a picture...There is an unexplored possibility of genuine semantics beyond the limits of discursive reasoning... Painting and photography do not have a vocabulary, as writing does, but both present symbolic images, or presentational images that are full of significance to the beholder."

It is interesting to note that the thought behind this quotation has been expressed to the full in some of the most brilliant commercial exhibits in the New York World's Fair. The National Film Board, which followed the early stages of the Sir George experiment with great interest, is using a development of the five screen projection and other advances on multi-image projection for its exhibit of the story of man in the 1967 World's Fair. But these triumphs of virtuosity, backed with budgets running up from $100,000 a minute of projection time and backed by unlimited technical facilities are beyond the means of teaching institutions which cannot hope to produce at more than $5 a minute, including all overhead charges.

Bearing this in mind, the Sir George experiment cannot claim full technical success but it can claim a teaching success. Budget problems cut off the experiment half-way, but the first fifteen of thirty lectures were tested in the first half of the 1963-64 school year. Student response was good; the gain in clarity and understanding was substantial; student discipline in classes up to four hundred was excellent; student attendance was maintained at a maximum level.

Two aspects were unsatisfactory; some students found it difficult to break away from the manuscript culture technique of listening to and transcribing dictated notes, and they pleaded for time out for 'lights-up' and a session of dictated notes, thus tending to destroy the essential feature of a continuous flow of interwoven ideas, verbal and pictorial; it seems patently absurd that in an age when reproduction is quicker and cheaper than ever before that students should be tied down to pre-Gutenberg learning techniques. The other failure showed up in the first term examinations; the examination papers were set on a linear culture pattern for a course based on an electronic culture pattern and failure was a natural consequence.

The success of the experiment lies in demonstrating that communication between lecturer and student, between knowledge and understanding, is attainable in such a way that can transfer the teaching values of small classes to the greater challenge of large classes.

It is with sound instinct that two of the new Canadian Universities have thrown out the American slogan, Publish or Perish, as a status test of scholarship. York University is emphasizing good teaching as a necessary adjunct of scholarship; Dr. Shum of Simon Fraser University is basing payment of faculty not on multiplicity of degrees but on the capacity to fill and keep a classroom filled throughout a course.

Communicate or Perish is a better slogan than Publish or Perish, but slick slogans have no place in university teaching in a world where, as Karl S. Popper says in his book, Open Society and its Enemies, the new electronic revolution which seals the entire human family into one single global tribe is no less confusing to man than the earlier revolution of phonetic literacy (the linear culture) that ended the medieval world.

Science has ridden the revolution with the greatest of ease but the Humanities hesitate to leave the ivory towers to plunge into the challenge of the new society where its responsibilities are equally great as they were during the earlier revolution of the Renaissance.

N.B. The word Humanities has been used in the American plural rather than the Scottish singular, and the capital initial has been used to relate the word to its specific university rather than its universal application.

Edmund Fancott
Lecturer in English

HOW EXPO '67 COULD PRESENT THE EARTH SCIENCES

(Recently published in The Canadian Institute of Mining and Metallurgy Bulletin)

Introduction

For the past few years, mining officials across Canada have been somewhat concerned with the decreasing number of students enrolled in the various mining and geological departments of our universities. Many proposals have been made to remedy this situation, and these will undoubtedly show some results in a few years. If the smaller enrollment is due to a decreased interest in the science, it is believed that the earth science exhibits of Expo '67 will help in renewing that interest. These exhibits will be an educational tool which may become a contributing factor in attracting young students to the fields of mining, geology, geophysics, geochemistry and other earth sciences.

The 1967 World's Fair, which will be Canada's main centennial celebration, will not be a trade fair but will be a cultural, artistic and scientific exposition where the accent will be placed on man himself rather than on his accomplishments, his organizations and his machines. The general theme of the Exposition - "Man and His World" - has been inspired by Antoine de Saint-Exupéry in his book "Terre des Hommes," and is very well suited to the earth sciences. "Etre homme" he writes, "..... c'est sentir en posant sa pierre que l'on contribue à bâtir le monde."* In all the exhibits, the relation between man and his environment will be emphasized, as well as his contribution to building the world. An effort will be made to show that the earth sciences are closely related to man's life and that a scientific knowledge of the problems involved is always for human betterment.

The general theme - "Man and His World" - is subdivided into four major subjects:

(1) "Man the Creator" (dealing with fine arts).
(2) "Man the Explorer" (life sciences and medicine).
(3) "Man the Producer" (physical sciences and medicine).
(4) "Man in the Community" (problems in community living - featuring Habitat '67).

The Earth Sciences

The earth sciences will be demonstrated under the theme "Man the Explorer," and will include three main sub-themes:**

(a) "Man and the Oceans"
(b) "Man and Land"
(c) "Man and the Polar Regions"

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* To be a man ... is to feel that, by one's efforts, one contributes to building the world."

** A fourth sub-theme, "Man and Space," had originally been planned. However, because of the tremendous advances made in this field in Russia and the United States, this topic will be covered in the pavillions of these countries.

Under these sub-themes, some of the topics depicted are expected to be: the atmosphere, climate, weather, polar regions, oceans, continents, mineral deposits, petroleum geology, geography, soils, geochemistry, geophysics, the upper mantle, the earth's interior, etc. There will be some intermingling of exhibits, as it is impossible to always assign a particular topic to a particular sub-theme.

Although the earth science displays will account for only a fraction of all the exhibits at the Exposition, they will play an important role. To house the displays, pavillions with a total floor space of 30,000 square feet are being planned.

In suggesting exhibits, answers to the following questions are sought. What do visitors want to know? What is the best way to tell it? Is it technically realizable? Efforts are made to have exhibits that appeal to all the senses, and that are colourful, dynamic, exciting, imaginative and, most of all, educational. "The exhibits should be 75 per cent educational and 25 per cent recreational" said Commodore O.C.S. Robertson, former deputy administrator of theme pavillions. To educate the visitors, major principles and/or theories should be the main ideas behind each exhibit.

For many exhibits, titles in the form of mottos, questions, statements or the principle itself will be used. Some displays will be aimed at people who have reached the grade IX level. This appears to be a little low, and, in many cases, the level will be raised, thus producing more challenging exhibits for the well informed visitors. Exhibits will be neither oversimplifield nor too highly popularized.

While examining attractive earth science displays, many young visitors may become interested in the subject depicted and will try to find the "why" and "how" of each display and to determine the principle involved. To draw the visitors' attention, static exhibits will be avoided as much as possible. For a number of displays, trained personnel will be available to answer questions and give general information. Experience has shown that most museum visitors will rarely take time to read inscriptions or written explanations accompanying displays. The use of personal audio receivers has been suggested to solve that problem. In the pavillions, visitors might be handed transistorized radios that, through the use of different frequencies, could receive explanations transmitted in different languages. These explanations, whether given by radio or by trained personnel, will serve to inform, educate and teach the visitors.

In some exhibits, visitors will be invited to participate. The participation, in some cases, may be limited to the pushing of buttons or the manipulation of levers; in others, however, it may be more involved, demanding skill, imagination and some rapid decisions and reflexes. The young visitors may, therefore, feel as if they are in a laboratory performing a scientific experiment. These will not be two-hour experiments, as two minutes is enough to bring home an idea and make a strong impression on a young student. After explanations of certain exhibits are given, interested visitors could be asked questions on the particular display or on the principle behind it. Interesting prizes may be given for original answers, with different categories of prizes for scientists, amateur scientists and students. Well-selected films on important earth science subjects will be projected. These again will be selected or prepared with the object of primarily informing and instructing the public while recreating the subject matter at the same time.

Instructive pamphlets describing some displays and the principles or theories involved will be available. Bookstores will display and sell books on all aspects of science and on the various scientific careers that a young person can follow.

For some exhibits, various hypotheses or theories may be given, telling the visitor that no particular hypothesis is generally accepted. We will thus show that, for many problems, we have no definite answer or explanation and that we have not yet reached the limit of knowledge. The field of earth sciences is, therefore, still wide open for research and new scientists. Perhaps a bright young visitor may decide that he will put his energy into an unsolved problem and aim his future studies in that direction.

Different committees and associations, and more than fifty scientists working under the chairmanship of J. Tuzo Wilson, geophysicist at the University of Toronto, have contributed suggestions and ideas along definite story lines for the earth science exhibits under the sub-theme "Man the Explorer." Out of the 150 or more displays that have been suggested by these earth scientists, a selection is being made with the help of the Expo officials in charge of thematic displays and the private display companies who will supply the detailed plans.*

Some of the Proposed Exhibits

The following are some of the exhibits that have been proposed. They are not final and may be changed or substituted for others.

One of the proposed exhibits is concerned with the earth's structure and interior. A rotating cut-away model of the earth will show the crust, the mantle and the core. A make-believe trip to the center of the earth will illustrate, with a flow of moving lights, how liquid currents in the core act as a dynamo and generate the earth's magnetic field.

There could also be a seismological station showing how earthquakes are caused, how their preliminary secondary and longitudinal waves are transmitted through the various parts of the earth and how they are recorded by the most modern instruments. Visitors could participate by starting miniature earth tremors, with the effects shown on seismographs. The destructive forces of earthquakes and tsunamis could also be illustrated, as well as the modern systems now used to warn against them.

A large globe with sliding continents will possibly be used to illustrate continental drift. It would show visitors that the crust of the earth, which appears to be stable, is actually very weak, considering the time and scale factors.

The mechanism of volcanic eruptions could also be shown, with visitors manipulating levers that will start the process. A three-dimensional dynamic model of Mount Royal in Cretaceous time would perhaps be a good illustration.

A series of animated diagrams or three-dimensional films may be used to demonstrate how horizontal strata are folded, how huge granite batholiths are emplaced and how mountains are formed.

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* The Institute of Design, University of Waterloo, Waterloo, Ont., has recently completed a conceptual design of an Earth Science Pavillion. This is an important step toward the final realization of the project.

Destructive forces always act simultaneously with the constructive ones, and agents of erosion will also be displayed. In the field of glaciation, a dynamic model of the earth, showing advancing and retreating ice sheets with the corresponding lowering and raising of the sea level, will probably be demonstrated. Here, viewers will be told that a drop of only 5°F could bring about a new period of glaciation and a lowering of the sea level. On the other hand, if a rise in temperature were to melt all of the present glaciers, the sea level would rise by some 100 feet and most of the important cities of the world would be submerged. This is an excellent place to show how science is closely related to man's life.

A freely mounted gyroscope or the Foucault pendulum could be used to demonstrate the earth's rotation, and the weight of common objects on the different planets could illustrate Newton's law. Visitors would handle these objects and feel their relative weights.

In trying to inform the visitors about the length of geologic time and the size of the universe, a logarithmic scale could be used. The origin of the earth can be placed at 4.5×10^9 years ago and a man's life at less than 10^2 years. The distance to the sun is 10^{13} cm., and the diameter of an atomic nucleus is 10^{-14} cm. Although it is realized that a number of visitors will not immediately grasp the meaning of a logarithmic scale, there are many who will once a brief explanation is given. This exhibit would also serve to show the small space occupied by the earth in the Universe, as well as the short duration of man's life span in respect to geologic time. This may diminish our ego.

Closely related to the length of geologic time, we could show the parade of life from algae to man. Here again, this would give us a good lesson in humility by showing the small space occupied by homo sapiens in the evolution chart. With most animal species having a life span of 0.5 million years, we will ask visitors what will happen to man in the year 450,000 A.D.? Some of the answers may prove to be quite interesting.

The earth is man's storehouse. We get our food from it, as well as our energy and our mineral supplies. So far, these entities have been derived mainly from the land area (29.2 per cent of the earth's surface). For his future needs, however, man may soon have to turn his attention to the oceans (70.8 per cent) or, in the more distant future, to another planet.

An exhibit on soils, their formation, varieties and conservation is suggested, and may be demonstrated by 3-D film. Soil constitutes man's most important material, as food is derived from it and our health depends on food.

To illustrate the earth's water supply, a working model of the hydrological cycle is proposed. This will be an exciting display showing how man benefits from the energy produced from the earth's water resources and illustrating the latter's influence on vegetation.

Other materials of the earth might be displayed, including precious and semi-precious stones and fluorescent minerals. Rock cutting, carving and polishing will add life to this exhibit. Such a display may stir an interest in mineralogy. Young visitors may become rock and mineral collectors and later amateur or professional mineralogists.

The various ways in which mineral deposits are formed could be depicted. To explain the formation of a salt bed, for example, a large basin of evaporation, with successive salts precipitating from sea water, could be set up.

Interesting and instructive displays on the various methods used in prospecting will provide excellent illustrations for the theme "Man the Explorer." These displays will cover both ground and air surveys, as used in geological, geophysical and geochemical studies. The use of a full-scale diamond drill to demonstrate how we obtain information on the rock formations below the earth's surface has been suggested. Panning for gold, as a prospecting tool, could also be depicted.

A working model of a mine, with shaft, stations, levels, raises, stopes, etc., may be set up to show the various phases of a mining operation. This could be done in a most realistic way with noise, darkness and underground water, and with visitors donning miners' hats and lights. Such a visit will illustrate many facets of mining.

The petroleum exhibits may describe theories on the formation of oil and on the accumulation and varieties of oil pools. Other instructive displays could show how the search for oil pools is carried out and how production is achieved from a well. A working model of a refining plant, with the various types of products obtained from the petroleum and petrochemical industries, may also be displayed.

The oceans will be given all of the attention they deserve. The exhibits for the sub-theme "Man and the Ocean" will probably be grouped under one distinct snail-shaped building. An artificial lake on the enlarged St. Helen island is expected to form an appropriate decor for these exhibits. Here, visitors will be taken on trips that will show them submarine topography, vegetation and animal life. Most of the visitors will be surprised to see the many interesting and rarely suspected features, such as the tremendous reserves of food, mineral wealth and power resources. Such a trip will be most instructive. Futuramic displays could also show how man can live and work in pressurized units.

In the field of geography, a large map of the world will show, by progressive illumination, how early man spread from Africa to all parts of the world. The great explorers and their routes will be shown, in chronological order, so as to illustrate the discovery of the world.

The migration of population during the past 300 years from high-density to low-density areas could also be shown on a large globe of the world.

The population explosion could be depicted by an inverted lighted pyramid. The major problems arising from the population explosion will be enumerated, and visitors will be asked to suggest original solutions.

The various layers enveloping our planet will also be well depicted, including the lower atmosphere, the troposphere, the stratosphere, the mesosphere and the ionosphere. At their proper levels will be shown the altitudes attained by planes, jets, radiosondes, rockets, balloons, meteors, cosmic rays, aurorae, satellites, etc.

Illustrations of meteorological phenomena such as weather, clouds, storms, rainbows, humidity, rain, blizzards, tornadoes, dust storms, an aurora and an eclipse may be included in the displays. Visitors will be admitted into a full-scale forecasting office or gallery, equipped with all the modern instruments.

The world's largest known meteorite, the Hoba West, is in Africa. Efforts are being made to borrow it for the duration of the Fair. This meteorite is bound to create a strong impression on many visitors.

These are only a few of the displays that have been proposed for the earth sciences. Others may and will be shown or substituted for the ones mentioned above. The selection of exhibits will be made primarily on the basis of their educational merit.

For all practical purposes, the earth science pavillions will be like a modern and up-to-date museum - a dynamic museum or showplace that will be very instructive and that will teach and educate the visitors as well as recreate the various phenomena.

A Permanent Showplace for the Earth Sciences

One of the big drawbacks of expositions is that there is so much to see and so little time available to study individual displays. The result is that the aims of many exhibits are often missed. The number of visitors at Expo '67 is expected to be 100,000 to 300,000 per day. In the earth science pavillions, visitors may go past the displays at a rate of about 1,000 per hour. Again this is too fast for the best educational results.

Thinking in terms of future years, an all-out effort should be made to construct a permanent building for the earth sciences. Many of the outstanding exhibits should be kept, and these could form the basis of a permanent showplace. If this can be done, visitors in post-Expo days will have more time to see, study and appreciate the various exhibits and the principles demonstrated. The benefit that the Canadian mining industry will derive from the 1967 World's Fair would then be extended and be of a permanent nature.

Teachers would find this building a wonderful educational tool for the teaching of the earth sciences, and students would find an ideal place to study the nature of earth sciences in a most pleasant atmosphere. It would bring these young minds closer to the problems connected with the earth sciences, stir their interest and encourage them to study the fields of geology and mining.

A.N. Deland
Asst. Prof. of Geology

SIR GEORGE WILLIAMS UNIVERSITY

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